PATENT ABSTRACTS OF JAPAN

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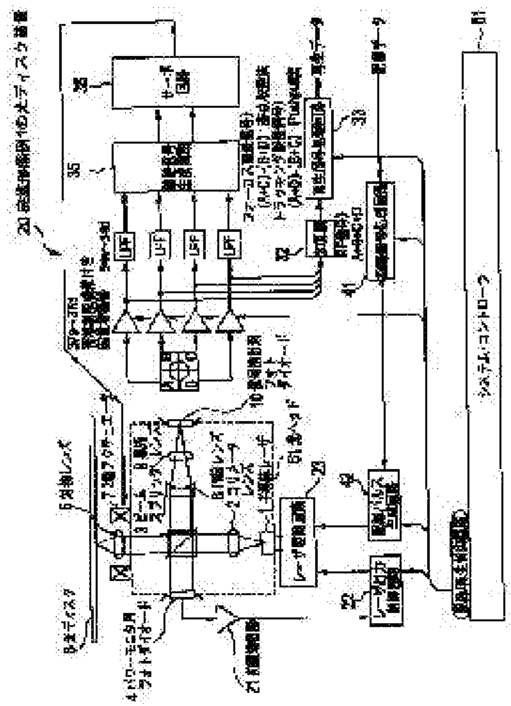
(54) **OPTICAL DISK DEVICE**



(57)Abstract:

PROBLEM TO BE SOLVED: To obtain an optical disk device arranged to improve the accuracy of the servo operation at the time of recording operation by preventing an error of a servo error signal without increasing the slew rate of a preamplifier.

SOLUTION: This device 20 is provided with an error detecting mechanism which is furnished with a signal detecting photodetector for receiving light reflected from the optical disk by a plurally dividing system and the preamplifiers for converting respective output currents of the signal detecting photodetector to voltages, and it is formed to the optical disk device such that an information signal is recorded to the optical disk by modulating the optical power ejected to the optical disk. The preamplifiers 37a-37d are furnished with frequency band limiting means for limiting a frequency band so that the frequency band limiting means are operated at the time of recording by the input of the recording/reproducing control signal and also not operated at the time of reproduction.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the optical disk unit provided with the composition which raises the servo performance at the time of recording operation more particularly about the optical disk unit which irradiates an optical disc with the modulated light power, and records information.
[0002]
[Description of the Prior Art]An optical disk unit is a recording and reproducing device of optical information recording media, such as an optical disc, Usually, the optical head which plays the information which recorded information on the optical disc and was recorded on the optical disc, It has the control circuit of the access mechanism which moves an optical head to the position of the request on an optical disc, the rolling mechanism which holds an optical disc and is rotated, an optical head, or an access system, the digital disposal circuit of playback/record signal, etc.
[0003]Here, with reference to drawing 6, the composition of the composition of the conventional optical disk unit especially a servo error detection system, and a multi-pulse recording system is explained. Drawing 6 is a block diagram showing the composition of the conventional optical disk unit. The conventional optical disk unit 11 is provided with the optical system, a data reproduction system and a servo error detection system, the multi-pulse recording system including data recording, etc.
The optical system optical disk unit 11 is provided with the optical system in the form packed by the optical head 61. Namely, an optical system, The semiconductor laser 1 provided as a light source, the collimating lens 2 which makes a laser beam a parallel beam, the beam splitter 3 which carries out the split of a part of parallel laser beam, the photo-diode 4 for power monitors, the object lens 5 which condenses a laser beam on the optical disc 6, and the object

lens 5 are supported, It comprises the biaxial actuator 7 to control, the cylindrical lens 8 which condenses the catoptric light of the optical disc 6, the condenser 9, and the photo-diode 10 for signal detection, and is accommodated in the optical head 61 as a package. The photo-diode 4 for power monitors carries out photoelectric conversion of the laser beam by which the split was carried out by the beam splitter 3, and outputs it as a light intensity signal of a laser beam, and the biaxial actuator 7 controls the object lens 5 to a focusing direction and a tracking direction according to instructions of the servo circuit 36.

[0004]In an optical system, the light emitted from the semiconductor laser 1 turns into a parallel beam through the collimating lens 2, and goes into the beam splitter 3. A part of light which entered into the beam splitter 3 reflects, photoelectric conversion is entered and carried out to the photo-diode 4 for power monitors, and it is outputted as current. After the output current of the photo-diode 4 for power monitors is changed into a voltage signal with the preamplifier 21, it is inputted into the laser output control circuit 22. The laser output control circuit 22 controls the laser drive circuit 23 so that the semiconductor laser 1 emits light in a laser beam by predetermined light power.

[0005]On the other hand, the light which penetrated the beam splitter 3 condenses on the optical disc 6 with the object lens 5. The object lens 5 is supported by the biaxial actuator 7. According to instructions of the servo circuit 36, it moves to a focusing direction and a tracking direction.

Again, it enters into the beam splitter 3, it reflects there, and is condensed by the cylindrical lens 8 and the condenser 9, and the light reflected with the optical disc 6 enters into the photo-diode 10 for signal detection. The photo-diode 10 for signal detection is divided into four photo detector 10 A-D, and an optical beam enters near [the] a center.

[0006]The data reproduction system optical disk unit 11 is provided with the preamplifiers 31a-31d, the adding machine 32, and the regenerative-signal processing circuit 33 as a data reproduction system. After the output current of the photo detectors 10A-10D is changed into a voltage signal with the preamplifiers 31a-31d, respectively, four voltage signal outputs are added by the adding machine 32, and a regenerative RF signal (A+B+C+D) is generated. A regenerative RF signal goes into the regenerative-signal processing circuit 33, and the data currently recorded on the optical disc is restored and it is played.

[0007]In the servo error detection system optical disk unit 11, the "focus servo" which makes light spot condense on the record film of the optical disc 6, and the "tracking servo" which makes the predetermined track of the optical disc 6 scan are performed. The optical disk unit 11 is provided with the preamplifiers 31a-31d, LPF(Low Pass Filter : low pass filter)34a-34d, the error signal generating circuit 35, and the servo circuit 36 as a servo error detection system. A servo error signal required for servo operation receives the optical beam reflected from the optical disc 6 by photo detector 10 A-D divided into four pieces two or more, and is

acquired by calculating the output of each photo detector 10 A-D by a prescribed method.
[0008]The composition of a servo error detection system of the optical disk unit 11 is an example of what used the push pull method for detection of a focus error signal at detection of astigmatic method and a tracking error signal. After LPF34a-34d removes an information signal component from a preamplifiers [31a-31d] output, the predetermined operation shown below in the error signal generating circuit 35 is performed, and a servo error signal is generated.
Focus error signal (astigmatic method) :(A+C)-(B+D)
Tracking error signal (the push-pull method): (A+D)-(B+C)
A focus servo and a tracking servo are performed by controlling the biaxial actuator 7 by the servo circuit 36 so that a servo error signal may maintain a predetermined value.
[0009]Although a servo error signal is generated by the operation of the output between photo detector 10 A-D by which the photo-diode 10 for signal detection was quadrisected in this way, For this invention mentioned later, I hear that the incident light quantity of each photo detector, therefore the output of each photo detector are not necessarily equal, and an important thing has them. The incident light quantity to each photo detector 10 A-D, therefore the output of each photo detector are changed by movement of the object lens accompanying the adjustment state of an optical system, inclination of an optical disc, and tracking operation etc.
[0010]In order to perform high density recording using what is called an "optical modulation recording system" that records an information signal on an optical disc by modulating the light power which carries out a multi-pulse recording system exposure, the temperature control on the record film of the optical disc 6 is important. Therefore, also when recording one recording mark, the light emitting waveform which combined two or more pulses is used. This is called "multi-pulse recording" and shows drawing 7 the example. Drawing 7 is a wave form chart showing a multi-pulse recording waveform. As the waveform of multi-pulse recording (simply henceforth a recording pulse) is shown in drawing 7, it comprises a train of impulses of record power, erase power, and cooling power, and the pulse number of record power differs from the pulse width of erase power according to the merits and demerits and the mark interval of a recording mark. Thus, the laser-light-emitting waveform at the time of record has a frequency component higher than the information signal recorded to Haruka.
[0011]In the optical disk unit 11 shown in drawing 6, record data is modulated, after required signals, such as an error correction code, are added in the recording signal processing circuit 41. In order to perform above-mentioned multi-pulse recording, a pulse signal row is generated in the recording pulse generating circuit 42, and it is sent to the laser drive circuit 23. The laser drive circuit 23 drives the semiconductor laser 1 so that light may be emitted by the light power which the timing which the recording pulse generating circuit 42 directs, and the laser output control circuit 22 direct.

[0012]The system controller 51 controls the optical disk unit 11 whole. For example, record/reproduction control signal is generated by the system controller 51 according to directions of record and reproduction, It is sent to the laser output control circuit 22, the recording pulse generating circuit 42, the regenerative-signal processing circuit 33, the recording signal processing circuit 41, etc., and each operation is made to change into reproduction motion or its reverse from recording operation.
[0013]Although there are a thread motor which rotates the optical disc 6 and to which a spindle motor and an optical system are radially moved as an element which is not illustrated to drawing 6, a servo system which accompanies them, an interface section which exchanges a signal with the exterior, etc., Since it was not related to this invention, it omitted here.
[0014]
[Problem(s) to be Solved by the Invention]By the way, the slew rate of the preamplifier of a servo error detection system has restriction, and it is above difficult [it] to enlarge to some extent so that it may mention later. Therefore, in connection with the recording pulse distortion resulting from the slew rate limiting of the preamplifier, the error arose in the servo error signal and there was a problem that it was difficult to raise the accuracy of the servo operation at the time of record in the conventional servo error detection system so that it might explain below. This problem is explained in detail below.
[0015](a) As distortion **** was carried out, it is reflected with the optical disc 6 and the recording pulse which consists of an optical pulse train with frequency higher to Haruka than an information signal and big amplitude in multi-pulse recording by the slew rate limiting of an amplifier enters into the photo-diode 10 for signal detection. An error is produced for the low-pass ingredient which this recording pulse receives nonlinear distortion by the slew rate limiting which is the preamplifiers 31a-31d, and is used for a servo error signal as a result. Here, with reference to drawing 8, the concept of the nonlinear distortion by the slew rate limiting of a preamplifier is explained. Drawing 8 is a wave form chart showing the waveform distortion and average level change by the slew rate limiting of a preamplifier. If waveform ** of the original recording pulse shown in drawing 8 (a) receives 20v [which was given to the preamplifier, for example]/microsecond slew rate limiting, it will become waveform ** of a recording pulse [as / as is shown in drawing 8 (a)].
[0016]The average level of waveform ** of the recording pulse which received the original average level and slew rate limiting of waveform ** of the recording pulse about the section for 120 ns illustrated to drawing 8 (a) is calculated, respectively.
** Area of the wave-like shading portion of the original recording pulse shown in wave-like average level drawing 8 (b) of an original recording pulse =1Vx (20ns+10ns+20ns)
= 50 V-ns therefore average level = area of the wave-like shading portion shown in wave-like average level drawing 8 (c) of the recording pulse which received 0.42V** slew rate limiting

=30 V-ns therefore average level = it is set to 0.25V.
[0017]That is, as a result of receiving the slew rate limiting of a preamplifier, the wave-like average level of a recording pulse falls to about 60% of the wave-like average levels of an original recording pulse. Even if the amplitude of waveform ** of an original recording pulse becomes still larger than 1V, since a difference becomes large further, without changing, waveform ** of the recording pulse which received slew rate limiting becomes what is called nonlinear distortion from which a size with error changes with amplitude.
[0018]Here, with reference to drawing 9, the concrete example based on a simulation result is given and explained further. Drawing 9 (a) is a circuit diagram showing the equivalent circuit of the model of a simulation, and drawing 9 (b) is a wave form chart showing the light wave form which enters into the photo-diode of a model. The model for simulations is the circuit which connected the photo-diode and the preamplifier with a return (current-voltage converter) in series, as shown in drawing 9 (a), As for 50 MHz (-3 dB) and a slew rate, 1.4V and the sensitivity (sensitivity [of a photo-diode] x (current-voltage conversion resistance)) of 20v/ [microsecond and] and maximum output amplitude are [small signal frequency band] 1000 V/W. And it asked for the output voltage average level to incidence power by simulation computation about the case where the light wave form shown in the photo-diode of a model at drawing 9 (b) is entered.
[0019]The light power of the light wave form which entered took Ppeak (peak power) and the binary of Pbias (bias power), and set to Pbias=0.2xPpeak. This light wave form is channel clock 50MHz (window width: Tw=20ns), and assumes the case where the mark and space of 4xTw width are recorded by turns, respectively.
[0020]The result of having carried out the simulation of the change of the output voltage average level to incidence power is shown in drawing 10. By drawing 10, a horizontal axis is Ppeak (peak power) which enters into a photo-diode, and a vertical axis shows the output voltage average level of a preamplifier. The solid line in drawing 10 is an average level of an original recording pulse, and a black rectangular head is an output voltage average level of a preamplifier. the output voltage average level of the preamplifier is lower than an original value, and the nonlinearity explained by drawing 8 is checked as incidence power increases and output voltage becomes large -- things can be carried out.
[0021]Next, Ppeak = the output voltage waveform of the preamplifier at 1200 microwatts is shown in drawing 11. A dashed line is an output wave of an original recording pulse among drawing 11, and a thick line is a waveform of the recording pulse which received 20v/microsecond slew rate limiting. Since it is restricted with the slew rate, it becomes a waveform of a linear polygonal line like ** of drawing 8 (a).
[0022](b) When the influence which amplifier slew-rate-limiting distortion has, thus a recording pulse receive slew-rate-limiting distortion with a preamplifier, produce an error for the low-pass

ingredient, and, moreover, the error changes with the output voltage of a preamplifier, i.e., the incident light quantity of a photo detector. On the other hand, as "PRIOR ART" explained, a servo error signal calculates each output current signal of plurality, for example, the photo detector divided into four pieces, by a prescribed method, and is generated. If the incident light quantity to each of all the photo detectors is the same incident light quantity, the error by slew-rate-limiting distortion will be offset in process of an operation, but. Actually, as mentioned above, since the incident light quantity of each photo detector is not necessarily equal therefore, error amounts will differ for every photo detector, and an error arises also in the servo error signal acquired by an operation. As a result, it is difficult for a focal gap and a track gap to arise during recording operation, and to perform high-precision record.

[0023](c) As one method of avoiding the problem slew-rate-limiting distortion accompanying slew rate increase, it is possible to increase the slew rate of a preamplifier. For example, a slew rate can be increased by increasing the bias current of a circuit and enlarging load driving capability. However, this has a problem of also making the noise which a preamplifier generates increase at the same time it causes the increase in power consumption. It is a technical problem with low-noise-izing of a preamplifier important in connection with the densification of an optical disc, and the increase in noise is not preferred. In order to attain broadband-izing and low noise-ization, a preamplifier is carried on an optical head in many cases, and generating of the heat by the increase in power consumption is connected with reducing the reliability of an optical system. In the photo detector which accumulated the photo-diode and the preamplifier on the monolithic and was especially stored in the transparent resin package, since generating of heat degrades the optical property of a package, the increase in power consumption should be avoided. In order to avoid slew-rate-limiting distortion so that clearly from the above explanation, it is not preferred to increase the slew rate of a preamplifier.

[0024]Then, the purpose of this invention is to provide the optical disk unit reduces the error of a servo error signal and it was made to raise the accuracy of the servo operation at the time of record, without increasing the slew rate of a preamplifier.

[0025]

[Means for Solving the Problem]In order to solve a technical problem mentioned above, an optical disk unit concerning this invention, A photo detector for signal detection which receives catoptric light from an optical disc by a rate method for two or more minutes, In an optical disk unit which has the servo error detecting mechanism provided with a preamplifier which changes output current of a photo detector for signal detection into voltage, respectively, irradiates an optical disc with modulated light power, and records information, A preamplifier is characterized by having a frequency band limit means which restricts a frequency band, and operating a frequency band limit means by the input of record/reproduction control signal at the

time of record, and making it not make it operate at the time of reproduction.
[0026]In this invention, at the time of recording operation, a frequency band limit means restricts a frequency band of a preamplifier for photo-diodes provided as an object for servo error signal generation, and recording pulse distortion by slew rate limiting of a preamplifier for photo-diodes is eased. Thereby, an error of a servo error signal can be reduced and accuracy of servo operation at the time of record can be raised.
[0027]At a suitable embodiment of this invention, a frequency band limit means is fc amp <=SRamp/(2x pixVo max), when setting a slew rate, maximum output amplitude, and a frequency band of a preamplifier under recording operation to SRamp, Vomax, and fcamp, respectively (1).
A frequency band of a preamplifier under recording operation is restricted so that it may be satisfied. pi is a circular constant.
[0028]In this embodiment, by the above composition, since receiving slew-rate-limiting distortion is lost, output voltage of a preamplifier does not produce an error of a servo error signal which is the low-pass ingredient, either. That is, servo operation also with under [highly precise] recording operation can be performed.
[0029]With reference to drawing 1 and drawing 2, an operation of a frequency band limit means of this invention is explained. Output signal Vo with which drawing 1 was band-limited with the damping time constant tau to a step-input signal of the amplitude Vo max The response characteristic of (t) is shown. If a standup of a step input is set to t= 0, this response characteristic is Vo. (t) =Vo max x {1-exp (- t/tau)} (2)
It is come out and expressed. The maximum slew rate SRmax which this response has is a case of t= 0, and is SRmax =dVo. (t)/dt$|_{t=0}$=Vo max /tau (3)
On the other hand, the -3-dB bandwidth fc of a system band-limited with the damping time constant tau is fc =(2x pixtau) $^{]1}$ (4).
It comes out. Therefore, fc =SRmax [from (3) types and (4) types] /(2x pixVo max) (5)
A relation to say is materialized.
[0030](5) From a formula, a system band-limited by fc will not have a slew rate ingredient exceeding SRmax calculated from a relation of (5) types. An ingredient which exceeds the slew rate SRamp of a preamplifier by restricting a frequency band of a preamplifier is lost so that (1) type may be filled during record, and it stops therefore, producing an error of a low-pass ingredient by slew-rate-limiting distortion.
[0031]Next, an example shown in drawing 9 explains an effect of frequency band restrictions of a preamplifier. Since it is SRamp =20v/microsecond and Vo max =1.4V in this example, it is fcamp<=20(v/microsecond)/(2xpix1.4).
What is necessary is just to band-limit to <=2.27MHz.
[0032]A frequency band was lowered to 2.27 MHz and a simulation was performed like an

example shown in drawing 9. Similarly a result of having carried out the simulation of the change of an output voltage average level to incidence power when a frequency band is lowered to 2.27 MHz is shown in drawing 10 as compared with 50 MHz of frequency bands. It is an output voltage average level of a preamplifier band-limited to 2.27 MHz of **, and was in agreement with an average level of an original recording pulse shown as a solid line. Ppeak = an output voltage waveform of a preamplifier which was 1200 microwatts is shown in drawing 2. By an effect of frequency band restrictions given to a preamplifier, an inclination of a polygonal line is remarkably loose compared with a waveform which received slew rate limiting shown in drawing 11, and it turns out that slew rate limiting is not received.

[0033]This invention has a deterrent effect also to an error of a servo error signal produced not only by distortion of a recording pulse but by overshooting or undershoot resulting from slew rate limiting.

[0034]In a still more suitable embodiment of this invention, a preamplifier provided with a frequency band limit means is provided with a switch and feedback capacity by which were connected with a feedback resister connected in parallel with an amplifier in parallel with an amplifier, and cascade connection was carried out mutually.

[0035]By setting so that it may be satisfied with this embodiment of a formula (1) in the damping time constant tau which becomes settled from a feedback resister and feedback capacity at the time of record. If a switch is carried out to one with the record/reproduction control signal from a system controller, a time constant circuit can work and a frequency band of a preamplifier can be restricted. At the time of reproduction, by turning OFF a switch with the record/reproduction control signal from a system controller, a frequency band limiting function disappears and current-voltage conversion of a broadband is performed.

[0036]In another, still more suitable embodiment of this invention, a preamplifier provided with a frequency band limit means is provided with a switch and feedback capacity by which were connected with the 1st feedback resister connected in parallel with an amplifier in parallel with an amplifier, and cascade connection was carried out mutually, and the 2nd feedback resister connected in parallel with feedback capacity.

[0037]In this embodiment, if a switch is carried out to one with the record/reproduction control signal from a system controller, since current-voltage conversion resistance falls in parallel resistance values of the 1st feedback resister and the 2nd feedback resister, it will become easy to avoid output saturation of a preamplifier by increase of output current of a photo detector for signal detection. By defining the damping time constant tau which becomes settled from parallel resistance values of the 1st feedback resister and the 2nd feedback resister, and feedback capacity so that a formula (1) may be satisfied, at the time of record. If a switch is carried out to one with the record/reproduction control signal from a system controller, a time constant circuit can work and a frequency band of a preamplifier can be restricted. At the time

of reproduction, by turning OFF a switch with the record/reproduction control signal from a system controller, a frequency band limiting function disappears and current-voltage conversion of a broadband is performed.

[0038]

[Embodiment of the Invention]The example of an embodiment is given to below and an embodiment of the invention is described to it concretely and in detail with reference to an accompanying drawing.

The example of the one example embodiment of an embodiment is an example of the embodiment of the optical disk unit concerning this invention, and the block diagram and drawing 4 (a) and (b) which drawing 3 shows the composition of the optical disk unit of this example of an embodiment are a circuit diagram of a preamplifier with a band limit function, respectively. The optical disk unit 20 of this example of an embodiment changed the preamplifiers 31a-31d for the photo-diodes for signal detection into the preamplifiers 37a-37d with a band limit function, as shown in drawing 3, Except for having inputted into the preamplifiers 37a-37d with a band limit function the record/reproduction control signal generated with the system controller 51, it has the same composition as the conventional optical disk unit 11 shown in drawing 6.

[0039]The preamplifiers 37a-37d with a band limit function, As it is a preamplifier without a profit change, the basic function of a preamplifier is current-voltage conversion and it is shown in drawing 4 (a), It is connected in parallel with the preamplifier 101, and comprises the feedback resister 102 which applies negative feedback to the amplifier 101, and the feedback capacity 103 and the switch 104 by which were connected in parallel with the preamplifier 101, and cascade connection was carried out. The output current from the anode of the photo-diode 106 is inputted into the inverted input end of the amplifier 101. By connecting the cathode of the photo-diode 106 to Vbias, and impressing reverse bias, improvement in the speed and high-sensitivity-izing of the photo-diode 106 are attained.

[0040]In the optical disk unit 20 of this example of an embodiment, at the time of recording operation, this composition restricts a preamplifiers [with a band limit function / 37a-37d] frequency band so that the conditions of (1) type may be fulfilled. Namely, by defining the damping time constant tau which becomes settled from the feedback resister 102 and the feedback capacity 103 so that a formula (1) may be satisfied at the time of record. If the switch 104 is carried out to one with the record/reproduction control signal from the system controller 51, a time constant circuit can work and the frequency band of the preamplifier 101 can be restricted. At the time of reproduction, by turning OFF the switch 104 with the record/reproduction control signal from the system controller 51, a frequency band limiting function disappears and current-voltage conversion of a broadband is performed.

[0041]Although a concrete frequency band changes with a system or devices to be used, for

example, by the simulation condition of drawing 9, a frequency band will be adjusted, as shown in drawing 5. That is, while giving a 50 MHz (-3 dB) frequency band at the time of signal regeneration, at the time of record, a frequency band is restricted to 2.27 MHz (-3 dB).

[0042]The example of the two example embodiment of an embodiment is another example of the embodiment of the optical disk unit concerning this invention. The optical disk unit of this example of an embodiment is provided with the same composition as the optical disk unit 20 of the example 1 of an embodiment except for the preamplifiers 37a-37d with a band limit function being preamplifiers with a profit change. The preamplifiers 37a-37d with a band limit function formed in the optical disk unit of this example of an embodiment, The 1st feedback resister 102 that is connected in parallel with the preamplifier 101 and applies negative feedback to the amplifier 101 as shown in drawing 4 (b), It is connected with the feedback capacity 103 and the switch 104 by which were connected in parallel with the preamplifier 101, and cascade connection was carried out mutually in parallel with the feedback capacity 103, and comprises the 2nd feedback resister 105 that applies negative feedback to the amplifier 101.

[0043]Since the incident light quantity to the photo-diode 106 becomes large at the time of record, the output of the preamplifier 101 may be saturated, but. Since current-voltage conversion resistance falls by the above composition in the parallel resistance values of the 1st feedback resister 102 and the 2nd feedback resister 105 by carrying out the switch 104 to one at the time of record, it is easy to avoid the output saturation of the preamplifier 101. By defining the damping time constant tau which becomes settled from the parallel resistance values of the 1st feedback resister 102 and the 2nd feedback resister 105, and the feedback capacity 103 so that a formula (1) may be satisfied, at the time of record. If the switch 104 is carried out to one with the record/reproduction control signal from the system controller 51, a time constant circuit can work and the frequency band of the preamplifier 101 can be restricted. At the time of reproduction, by turning OFF the switch 104 with the record/reproduction control signal from the system controller 51, a frequency band limiting function disappears and current-voltage conversion of a broadband is performed.

[0044]

[Effect of the Invention]As stated above, this invention can be prevented in connection with recording pulse distortion to which a recording pulse originates in the slew rate limiting of a preamplifier by restricting the frequency band of the preamplifier of the photo detector for signal detection for an error arising in a servo error signal at the time of record. Since this invention has a deterrent effect also to the error of the servo error signal produced not only by distortion of a recording pulse but by overshooting or undershoot resulting from slew rate limiting, By both effects, also at the time of recording operation, servo error detection without error is enabled and high-precision servo operation can be realized. As a result, the high-

density-recording performance of an optical disk unit can be raised.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is a figure explaining the ability to restrict the maximum slew rate which a signal has by restriction of a frequency band.
[Drawing 2]It is a figure showing the result of having carried out the simulation of the waveform from which the recording pulse received frequency band restrictions.
[Drawing 3]It is a block diagram showing the composition of the optical disk unit of the example 1 of an embodiment.
[Drawing 4]Drawing 4 (a) and (b) is a circuit diagram of the preamplifier with a band limit function which has a profit change, respectively and it does not have a profit change.
[Drawing 5]It is a graph which shows change of the frequency characteristic of the preamplifier by a band limit function.
[Drawing 6]It is a figure showing an example of the composition of the conventional optical disk unit.
[Drawing 7]It is a wave form chart showing a multi-pulse recording waveform.
[Drawing 8]It is a figure with which an average level explains changing in connection with distortion by slew rate limiting [respectively as opposed to a pulse signal in (c)], and it from drawing 8 (a).
[Drawing 9]It is a figure explaining the model which carried out the simulation of the average level change by the slew-rate-limiting distortion of a recording pulse. Drawing 9 (a) shows the composition of a model which carried out the simulation, and drawing 9 (b) shows the assumed incident light waveform.
[Drawing 10]It is a figure showing the result of having carried out the simulation of the change of the output voltage average level to incidence power about the slew-rate-limiting distortion of a recording pulse.
[Drawing 11]It is a figure showing the result of having carried out the simulation of the

waveform from which the recording pulse received slew-rate-limiting distortion.

[Description of Notations]

1 .... A semiconductor laser, 2 .... A collimating lens, 3 .... Beam splitter, 4 .... The photo-diode for power monitors, 5 .... An object lens, 6 .... Optical disc, 7 .... A dual shaft actuator, 8 .... A cylindrical lens, 9 .... Condenser, 10 .... The photo-diode for signal detection, 21 .... The preamplifier for power monitors, 22 .... A laser output control circuit, 23 .... A laser drive circuit, 31a-31d .... The preamplifier for signal detection, 32 .... An adding machine, 33 .... A regenerative-signal processing circuit, 34a - 34 d....LPF (low pass filter), 35 .... An error signal generating circuit, 36 .... A servo circuit, 37a-37d .... A preamplifier with the band limit function for signal detection, 41 [.... An optical head, 101 / .... An amplifier, 102 / .... A feedback resister, 103 / .... Feedback capacity, 104 / .... A switch, 105 / .... The 2nd feedback resister, 106 / .... Photo-diode.] .... A recording signal processing circuit, 42 .... A recording pulse generating circuit, 51 .... A system controller, 61

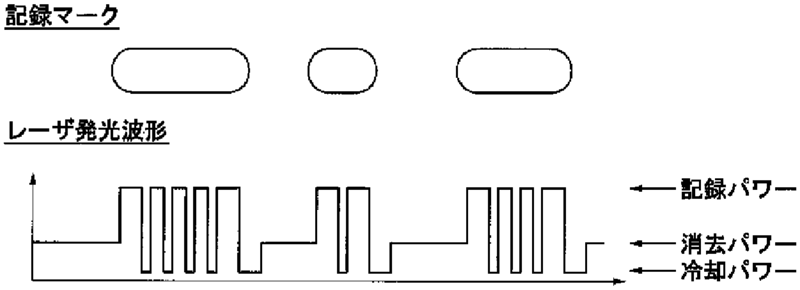
[Translation done.]

* NOTICES *

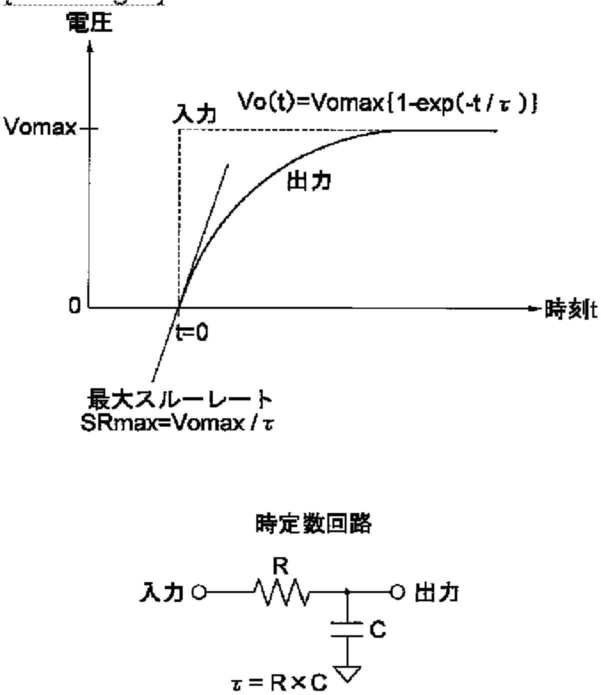
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

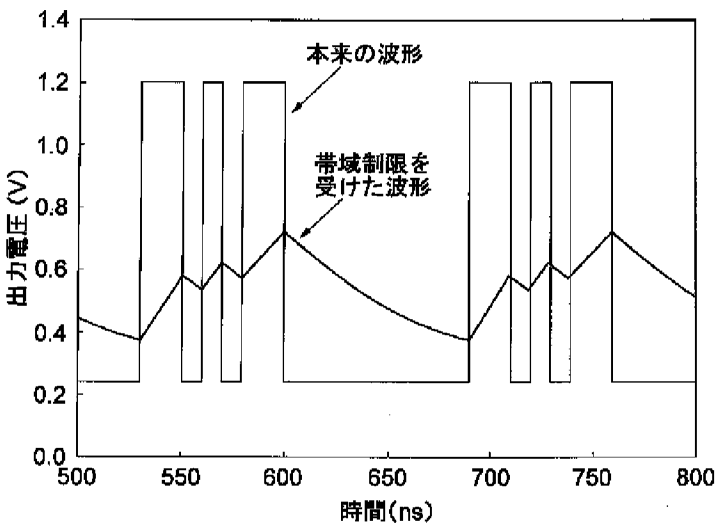
[Drawing 7]



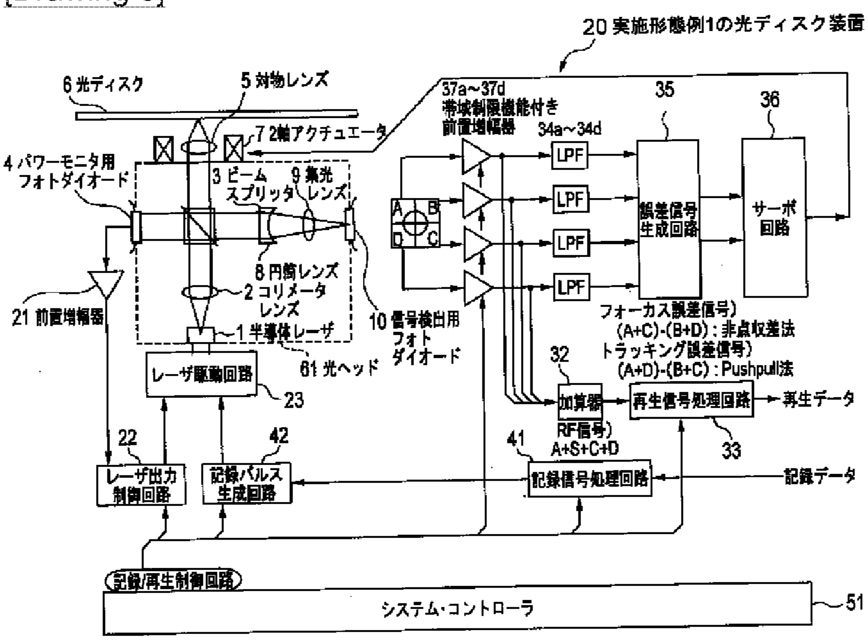
[Drawing 1]



[Drawing 2]



[Drawing 3]



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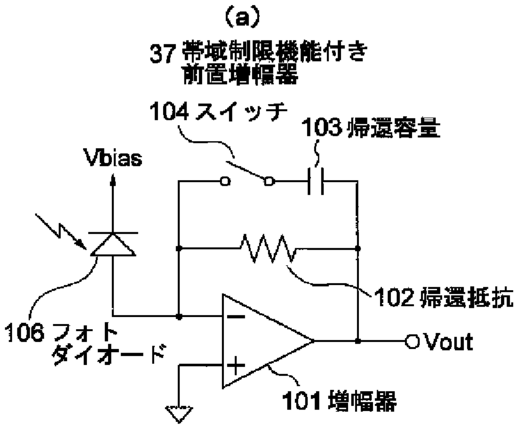
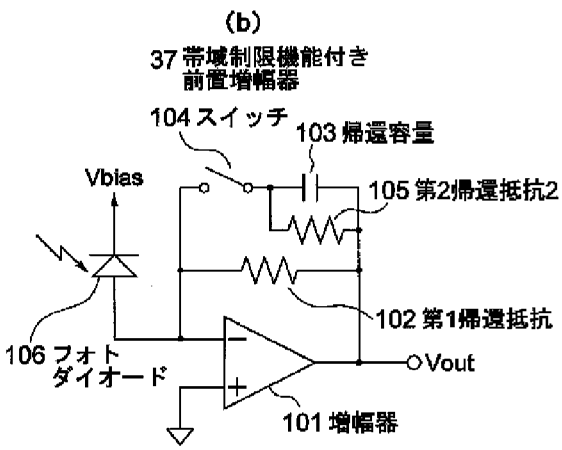
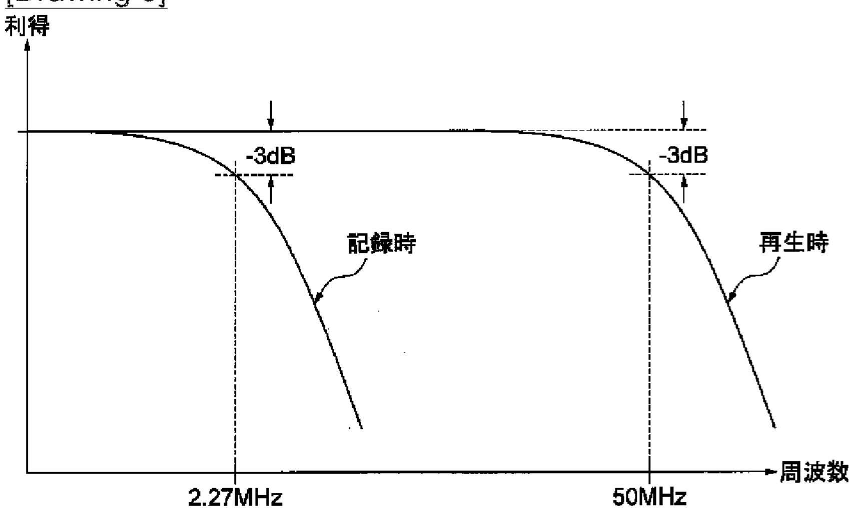
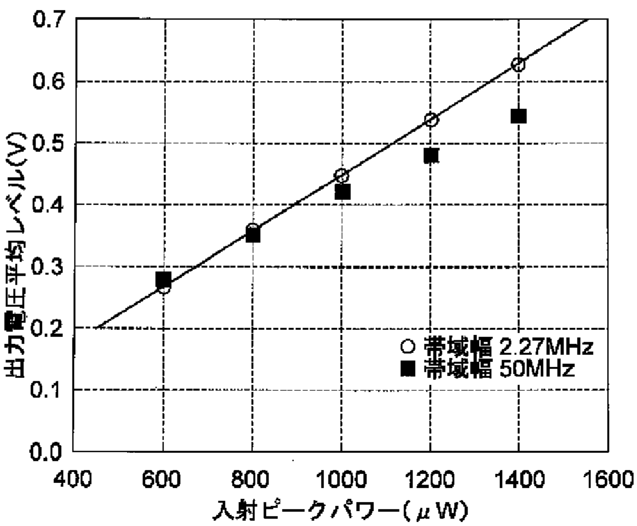




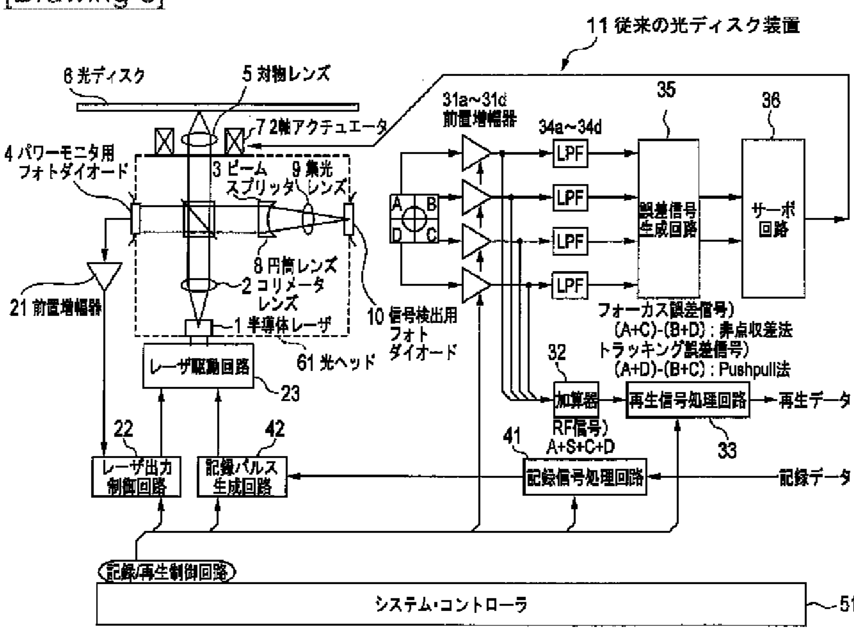
[Drawing 5]



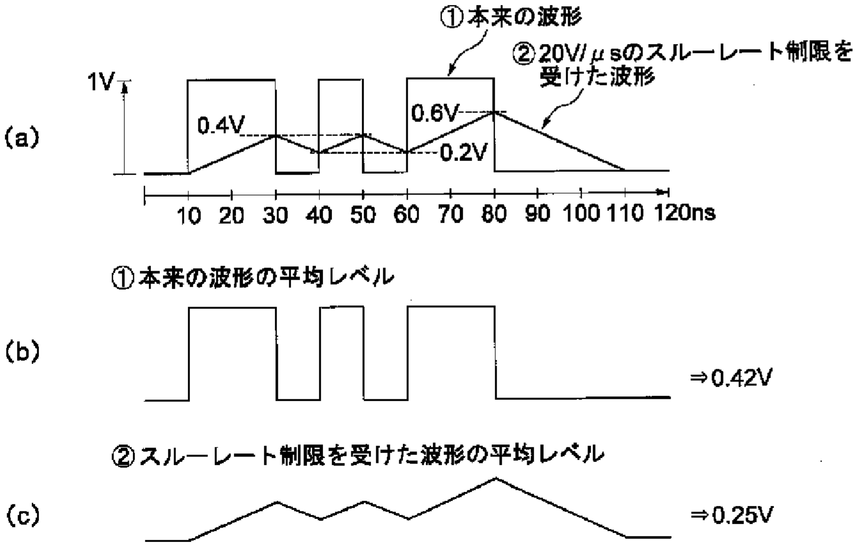
[Drawing 10]



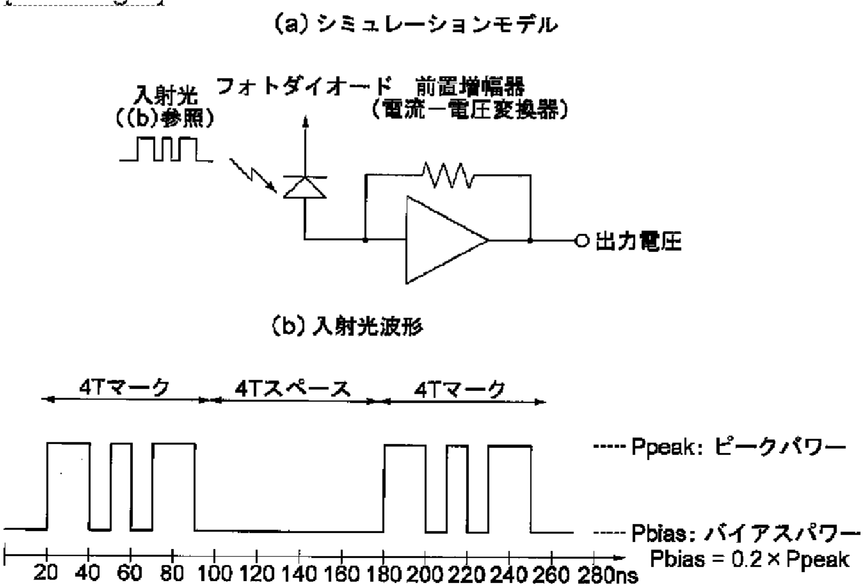
[Drawing 6]



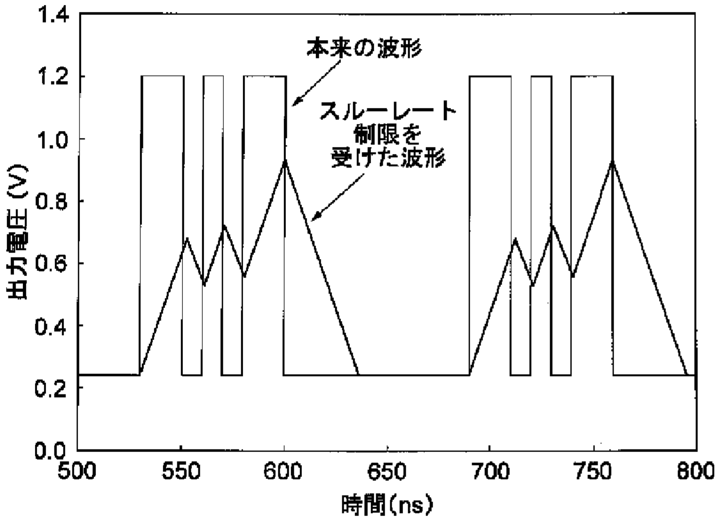
[Drawing 8]



[Drawing 9]



[Drawing 11]



[Translation done.]